
# Limited Visual Dam Safety Inspection Summary Report

## MA-138

## Kahakapao Reservoirs

## Maui, Hawaii

**Prepared by:**

**U.S. ARMY CORPS OF ENGINEERS**
**HONOLULU ENGINEER DISTRICT**

**STATE OF HAWAII**
**DEPARTMENT OF LAND AND NATURAL RESOURCES**

**May 2006**

**Dam ID: MA-0138**
**Name: Kahakapao Reservoirs**

Limited Visual Dam Safety Inspection Conducted on: 05 April 2006

## I. Purpose

Due to disaster occurrences of periodic heavy rains and flooding, which has caused extensive damage to property and loss of lives, the Governor has issued a State of Emergency Proclamation extending from February 20, 2006 to April 9, 2006. In light of the tragic failure of the Kaloko dam on Kauai and the continued forecast of heavy rains, emergency inspections of all regulated dams in all counties are being undertaken.

These inspections are for the purpose of determining if any of the regulated dams and reservoirs in the City and County of Honolulu, Maui County or Hawaii County, are suspect for immediate concern to the downstream area under the prolonged conditions of heavy rain showers.

## II. Authority

Inspections are authorized under the Hawaii Dam Safety Act of 1987, Chapter 179D "Dams and Reservoirs" of Hawaii Revised Statues, and Title 13, Subtitle 7, Chapter 190, "Dams and Reservoirs" of the Hawaii Administrative Rules.

These inspections are being conducted under joint agreements of the U.S. Army Corps of Engineers (USACE), the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS), and the State of Hawaii. The Memorandum of Agreement with the U.S. Army Corps of Engineers is entered into pursuant to 10 U.S.C. § 3036(d)(2), and the Intergovernmental Cooperation Act (31 U.S.C. §6505), and established via support agreement number DL-06-01.

## III. Scope

Visual inspection will be made on parts of the embankment and appurtenant works readily available and visible for inspection by the inspection team at the time of the inspection. Such parts and appurtenant works would include the upstream slope, crest, downstream slope, abutments and toes, outlet works, and spillway.

On the date of this limited visual inspection, there may appear to be no immediate threat to the safety of the dam, however no assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

## IV. Limitations of Findings and Recommendations

The inspection is based only on visible features/areas of the dam on the day of inspection. The inspection does not entail detailed stability, hydrologic, hydraulic, or seismic investigations. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies.

## V. Inspection Team

| Organization | Name /Title |
|---|---|
| U.S. Army Corps of Engineers | Troy O'Neal, P.E.<br>Geotechnical Engineer |
| State of Hawaii, Dept. of Land and Natural Resources | Gordon Chong<br>Engineering Division |

## VI. Owner's Representatives Present

| | |
|---|---|
| Maui County, Department of Water Supply | Walter Hager<br>Paul Seitz |

## VII. Summary Report Team

| Organization | Name |
|---|---|
| U.S. Army Corps of Engineers | Derek Chow<br>Bill Empson |
| State of Hawaii, Dept. of Land and Natural Resources | Denise Manuel<br>Edwin Matsuda |

## VIII. Dam Type

The dam appeared to be an earthen embankment dam.

## IX. Dam Classification

The current hazard classification of this dam is: High

Hazard Potential Classification based on the following:

| Category | Loss of Life | Economic Loss |
|---|---|---|
| Low | None Expected | Minimal (undeveloped to occasional structures or agriculture) |
| Significant | Few (No Urban development and no more than a small number of inhabitable structures) | Appreciable (Notable agriculture, industry or structures) |
| High | More than a few | Extensive community, industry or agriculture. |

Based on inventoried storage and height data, the size classification of the dam is: Most likely small but insufficient information is available to inspectors to make a determination.

Size Classification based on the following:

| Category | Storage (Acre-Feet) | Height (feet) |
|---|---|---|
| Small | < 1000 | < 40 |
| Intermediate | > 1000 and < 50,000 | > 40 and < 100 |
| Large | > 50,000 | > 100 |

## X. Summary of Inspection

Condition Rating Criteria: The conditional terms in this report are used to generally describe the conditions below. Inspections, monitoring, and additional investigations are considered to be incidental to all condition ratings.

| | |
|---|---|
| Satisfactory | Expected to fulfill intended function. |
| Fair | Expected to fulfill intended function, but maintenance is recommended. |
| Poor | May not fulfill intended function; maintenance or repairs are necessary. |
| Unsatisfactory | Is not expected to fulfill intended function; repair, replacement, or modification is necessary. |
| Unknown | Not visible, not accessible, not inspected, or unable to determine the condition rating based on the observation taken. |

**Dam ID: MA-0138**
**Name: Kahakapao Reservoirs**

**A. General appearance:**
The reservoir consists of two 50 million gallon impoundments with an earth dam construction from cutting into the upstream hillside. The dam height is roughly 30 feet tall and is relatively young (1990) compared to other reservoirs in the area. The crest of the dam is constructed of concrete and the bisect between each impoundment is also concrete. The pools are 28 feet deep and a staff gage is located in the middle of each pool near the inside edge (bisection).

Findings and Corrective Actions:
a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
b. An EAP is recommended for High Hazard Dams. Submit an updated EAP for this facility.
c. Routine inspection logs were not inspected.
d. Access to site appears to be satisfactory.
e. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
f. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
g. Emergency Alarms / Monitors: There were no alarms or monitors observed on this reservoir.
h. Power / Communication: There were no communication systems observed on this reservoir.

**B. Access / Security:**
Access to the dam was accomplished via a County roadway and extensive four wheel driving.

Security issues. Access to the dam is generally unrestricted though passage through 3 gates was required to get to the site.

**C. Intake Works:** (Satisfactory)
There is one intake pipe that is approximately 42 inches in diameter that is from the Waikamoi Dam #2 reservoir. The control of the intake pipe is by a valve that can be shut off or bypassed.

Findings and Corrective Actions:
a. The intake works were not tested.
b. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.

**D. Reservoir:** (Satisfactory)
The reservoir was 28 feet per gage at the time of inspection. The normal operating level is 28 feet per gage, and it is kept at the same level except during drought. A staff gage was observed on the stairs in the middle of the reservoir.

Findings and Corrective Actions:
a. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.

**E. Upstream Slope:** (Satisfactory)
The upstream slope was 1 on 2 slope and consisted of HDPE liner overlain with shotcrete.

Findings and Corrective Actions:
a. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.

**F. Crest:** (Satisfactory)
The dam crest was approximately 20 feet wide. The roadway access was approximately 15 feet wide at the time of inspection.

Findings and Corrective Actions:
a. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
b. Access along the crest was satisfactory.

**G. Downstream Slope:** (Satisfactory)
The downstream slope was approximately 1 on 2.5 slope and consisted of low ground cover. Sinkholes were not observed on the downstream slope. Seepage was observed and located near the left end of downstream slope at the toe. The flow is very minor that was reported to be spring water prior to construction. Additionally the seep is located near the soil bedrock interface based on construction layout at the site. The seep was clear. The seepage is very minor and likely to be unrelated to impoundment.

Findings and Corrective Actions:
a. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
b. Seepage was observed. Monitor and report and change in current condition.

**H. Abutments / Toe:** (Satisfactory)
The abutments and toe were visible and consisted of low ground cover. No seepage was observed in the abutments.

Findings and Corrective Actions:
a. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.

**I. Outlet Works:** (Fair)
The outlet works consist inlet pipes submerged in each reservoir that transverse to a control house located just downstream of the reservoir site. A 42-inch diameter DIP pipe was reported to exit toward a downstream treatment plant.

Findings and Corrective Actions:
a. The outlet works were not inspected.
b. The outlet works were not tested.
c. The outlet works appeared to be in fair to poor condition and requires corrective action.
d. The control house with underground piping from submerged outlets in reservoirs.

**J. Spillway:** (Satisfactory)
This spillway consisted a dual morning glory (3 feet in diameter), one in each reservoir. The spillway approach was clear. There was no erosion observed where the spillway exits to daylight.

Findings and Corrective Actions:
a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.

**K. Down Stream Channel:** (Unknown)
There is a well-defined downstream channel. There is a gouge on either side of each spillway.

Findings and Corrective Actions:
a. The downstream channel was not inspected.

## XI. Additional Comments:

Based on visual observations and discussion of operational procedures of the day, there is no immediate threat to the safety of the dam at this time.

Continue to monitor known seep and report any significant changes in flow.

**PHOTOGRAPHS**

# MA-138 Kahakapao Reservoirs

# MA-138 Kahakapao Reservoirs

138 View of downstream seep at left corner, reported to be from rock interface

MA-138 Kahakapao Reservoirs

138 Morning glory spillway - One of two morning glory spillways that exit to diversion ditches.

MA-138 Kahakapao Reservoirs

138 Downstream slope and cover looking to right end of reservoir.

# FIELD INSPECTION SHEETS

Dam ID: MA-138
KAHAKAPAO RESERVOIRS

**Vulnerability Index:**
Extreme 1 | High 2 | Moderate 3 | Low 4

**Inspection No:**
**Date:** 4/5/06

**STATE OF HAWAII - DLNR**
**DAM SAFETY INSPECTION SHEET**

**Inspection Type:** Visual Dam Safety Inspection

| Persons Present | Affiliation | Phone Number |
|---|---|---|
| TROY O'NEAL | US Army Corps of Engineers | |
| GORDON CHONG | DLNR | |
| PAUL SEITZ | MAUI CO. DEPT OF WATER | |
| | | |
| | | |
| | | |
| | | |

**Weather Condition:** ☐ Rain previous day ☐ Rainy ☐ Drizzle / Mist ☐ Cloudy/Overcast ☒ Partly Cloudy ☐ Sunny ☐ Dry

Comments:

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**1. General:** *(Information currently on file, update as required)*

| | | | |
|---|---|---|---|
| Dam/Res. Name | KAHAKAPAO RESERVOIRS | | |
| Owner | Maui County, Department of Water Supply | | *(C037)* |
| Owner Contact | Mr. Walter Hager | Owner Ph. | |
| Lessee | N/A | Lessee Ph. | |
| O & M Contractor | Owner | O & M Ph. | |
| Nearest Town | | Latitude | 20.8125 ° (decimal) |
| County | MAUI | Longitude | 156.2708 ° (decimal) |
| Tax Map Key(s) | (2)2-4-016:001 & 2-3-005:004 | | |

| | | | | | |
|---|---|---|---|---|---|
| Dam Status | A: | Hazard Potential | H: | Dam Size | L |
| Year Completed | 1990 | Dam Length | 2000 ft. | Dam Height | 20-30 20 ft. |
| Normal Storage | ac.ft. | Max. Storage | 309 ac.ft. | Max. Surface Area | ac. |
| Drainage Area | 0 mi. | Spillway Type | Culvert | Max. Spillway Q | cfs |

Owner owns land under dam facility:
Emergency Action Plan on file with the Department: N
Reports on file with the Department: Original Design Specs and Dwgs in DLNR Construction File

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KAHAKAPAO RESERVOIRS

**Inspection No:** _____
**Date:** 4/5/06

**2. Questions for Owner's Rep.:**

| | Yes | No | Unknown | Comments |
|---|---|---|---|---|
| Construction Plans Available | ☒ | ☐ | ☐ | |
| Site / Facility Map | ☐ | ☒ | ☐ | |
| Operation & Maintenance Manual | ☐ | ☒ | ☐ | |
| Emergency Action Plan | ☐ | ☒ | ☐ | |
| Modifications / Improvements | ☐ | ☒ | ☐ | |
| Conduct Routine Inspections | ☒ | ☐ | ☐ | |
| Conduct Routine Maintenance | ☒ | ☐ | ☐ | |
| Vehicle access to site | ☒ | ☐ | ☐ | ☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive |
| Access during heavy rains | ☒ | ☐ | ☐ | ☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive |
| Access when spillway is flowing | ☒ | ☐ | ☐ | ☐ Not accessible ☐ With Standard car ☒ Requires 4-Wheel Drive |
| Other Studies Conducted | ☐ | ☒ | ☐ | ☐ Phase I ☐ Phase II ☐ Hydraulics ☐ Stability ☐ Hazard ☐ Seismic ☐ Other: _____ |
| Incident History | ☐ | ☒ | ☐ | ☐ Breached ☐ Overtop ☐ Slide ☐ Down stream Flooding ☐ Other: _____ |
| Reservoir's Current Use | ☒ | ☐ | ☐ | ☐ Sediment ☒ Irrigation ☐ Recreation ☐ Flood Control ☐ Drinking Water ☐ Power Generation ☐ Other: _____ |

***Findings and Corrective Actions:***

- ☒ a. The Owner shall maintain documentations including Construction plans, specifications, improvements, modifications, Operations and Maintenance Manuals and routine inspection logs for this dam facility.
- ☐ b. An Emergency Action Plan (EAP) is on file with the department, submit any updates as applicable.
- ☒ c. An EAP is required for High Hazard Dams. Submit an updated EAP for this facility.
- ☐ d. An EAP is recommended for all dams regardless of hazard class. Submit EAP if developed for the facility.
- ☐ e. Submit narrative and additional information detailing the improvements, modifications, and/or alterations at the dam site, unless covered by approved dam permit.
- ☒ f. Routine inspection logs were not inspected.
- ☐ g. Dam owners shall provide for routine inspection of the dam.
- ☐ h. The dam did not appear to be maintained on a regular basis.
- ☒ i. Access to site appears to be satisfactory.
- ☐ j. There is no vehicular access to the dam site. Operational and emergency plans need to reflect this deficiency or access provided.
- ☐ k. Access to dam is questionable during severe weather conditions and/or spillway overflows. Operational plans and emergency plans need to reflect this deficiency or access provided.
- ☐ l. Provide a detailed narrative of the incident, responses taken, and any damages incurred. Dam owners are required to promptly advise the department of any sudden or unprecedented flood or unusual or alarming circumstance or occurrences which may adversely affect the dam or reservoir.
- ☒ m. Submit current Operations and Maintenance Manual or Procedures for this dam / reservoir facility.
- ☒ n. Submit Site or Facility Map of this Dam which identifies the location of major features including outlet works controls and conduits.
- ☐ o. _____

***Additional Requirements:***

The following investigative study(s) are:

| Required | Recommended | |
|---|---|---|
| ☐ | ☐ | Phase I Study |
| ☐ | ☐ | Phase II Study (Including ☐ Seepage ☐ Hydrology/Hydraulics ☐ EAP) |
| ☐ | ☐ | Hydrology and Hydraulics (including Probable Maximum Flood and spillway capacity) |
| ☐ | ☐ | Stability Analysis |
| ☐ | ☐ | Seismic Analysis |
| ☐ | ☐ | Hazard Classification |
| ☐ | ☐ | Other: _____ |

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**Physical Dam Features:** (Check All Applicable. Provide description of Items Observed and/or Take Photos. Indicate photo # in description.)

**3. Reservoir:**

Level during inspection 28 ft per GAGE (gage / other)

Normal Operating Level/Range 28 ft per GAGE (gage / other)

Description: KEPT AT SAME LEVEL EXCEPT DURING DROUGHT

Typical Operation ☐ Spillway always flowing ☒ Kept within normal range ☐ Kept Empty ☐ Drained Daily ☐ Only filled by Storms
☐ Other: ↑28 FT.

Sinkhole in Res.: ☐ # Observed: _____ Size: _____ by _____ in. Deep ☐ Not Visible ☐ None Observed
Description: _____

Staff Gage: Description: ON STAIRS IN MIDDLE OF RESERVOIR

***Findings:***

☐ a. The reservoir was not inspected.
☒ b. The reservoir appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The reservoir appeared to be in fair to poor condition and requires corrective action.
☐ d. The reservoir appeared to be in unsatisfactory condition, urgent corrective action is required.

***Corrective Actions:***

☐ e. The staff gage needs maintenance and/or repair. Description: _____
☐ f. A staff gage was not observed at the reservoir. Provide some method of quantifying the water level within the reservoir.
☐ g. A sinkhole was observed in the upstream reservoir. Conduct additional investigations and monitoring to identify the cause, risk and appropriate action.
☐ h. _____

**4. Intake Works Description:**

☒ Number of Intakes 1
☒ Intake Culvert / Pipe
Size: ≥42 in. ☒ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____
Control: ☐ Gate ☒ Valve ☒ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☒ Reservoir ☐ Other _____

☐ Ditch / Flume
Dimension: _____ (Size x Depth) Shape _____
Surface: ☐ Dirt ☐ Wood ☐ Concrete ☐ Lined w/ _____
Control: ☐ Gate ☐ Valve ☐ Flow can either be Shut off or Bypassed
From: ☐ Stream Diversion ☐ Pump ☐ Reservoir ☐ Other _____

***Findings:***

☐ a. The intake works were not inspected.
☒ b. The intake works were not tested.
☒ c. The intake works appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ d. The intake works appeared to be in fair to poor condition and requires corrective action.
☐ e. The intake works appeared to be in unsatisfactory condition, urgent corrective action is required.

***Corrective Actions:***

☐ f. The intake works needs maintenance and/or repair. Description: _____
☐ g. _____

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**5. Upstream Slope:** (Typical Slope ± 2 : 1)

Slope Protection: ☐ None ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☐ Liner _____ ☒ Other: HDPE LINER AND SHOTCRETE OVERLAY
☐ Defect in Protection: Description: _____

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____

Sinkholes: ☐ # Observed: _____ Size: _____ and _____ Depth ☐ Not Visible ☒ None Observed
Description: _____

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

***Findings:***

- ☐ a. The upstream slope was not inspected.
- ☒ b. The upstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The upstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The upstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The upstream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ j. Tree(s) were observed on the dam embankment. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ k. _____

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**6. Crest:** Approximate Crest Width: 20'

Access: ☐ None ☐ Walking Path ☒ Roadway, Surface / Width / Usage: 15'

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☒ None Observed

Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

***Findings:***

- ☐ a. The dam crest was not inspected.
- ☒ b. The dam crest appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The dam crest appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The dam crest appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

- ☒ e. Access along the crest was satisfactory.
- ☐ f. Access along the crest was not possible. Description: _____
- ☐ g. Rut and/or Gully erosion was observed on the crest, which requires maintenance and/or repair. Description: _____
- ☐ h. A crack was observed on the crest, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ i. A sinkhole was observed on the crest, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ j. Portions of the crest were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ k. Tree(s) were observed along the dam crest. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☐ l. _____

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|---|---|

**7. Downstream Slope:** (Typical Slope ± 2.5 : 1 )

Access: ☒ lower roadway along toe ☐ roadway to outlet works ☐ walkway to outlet works ☐ None Observed

Slope Protection: ☒ None ☐ Dumped Rock ☐ Rip Rap ☐ Grouted Rip Rap ☐ Concrete

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed

Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed

Description: _____

Sinkholes: ☐ _____ in. Wide x _____ in. Long x _____ in. Deep ☐ Not Visible ☒ None Observed

Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"

Description: _____

Seepage: Seep Spot Number 1 – LOCATION NEAR LEFT END OF DS SLOPE AND TOE

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☐ None Observed

☒ Flowing, Description: VERY MINOR SEEP THAT WAS RPT. TO BE SPRING PRIOR TO CONST. WAS NEAR ROCK INTERFACE.

Water Clarity: ☒ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: VERY MINOR AND LIKELY UNRELATED TO IMPOUNDMENT

Seep Spot Number 2

☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

***Findings:***

- ☐ a. The downstream slope was not inspected.
- ☒ b. The downstream slope appeared to be in satisfactory condition, no corrective actions are required at this time.
- ☐ c. The downstream slope appeared to be in fair to poor condition and requires corrective action.
- ☐ d. The downstream slope appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

- ☐ e. Slope protection needs maintenance or repair. Description: _____
- ☐ f. Rut and/or Gully erosion was observed on the slope, which requires maintenance and/or repair. Description: _____
- ☐ g. A crack was observed on the slope, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
- ☐ h. A sinkhole was observed on the slope, which requires further investigation to determine the underlining cause. Repair and monitor the area.
- ☐ i. The down stream slope was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
- ☐ g. Tree(s) were observed on the downstream slope. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
- ☒ h. Seepage/~~Ponding wate~~r was observed. Monitor and REPORT AND CHANGE IN CURRENT CONDITION. ~~conduct further investigation to locate the source of water and extent of any possible hazardous or developing conditio~~n.
- ☐ i. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
- ☐ j. The slope was very steep, around a 1 to 1 slope, further study is required to verify slope stability.
- ☐ k. _____

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**8. Abutments/Toe:**

Erosion: ☐ Loose soil w/ little vegetation ☐ Rut (<6") ☐ Gully (>6" deep) ☐ Not Visible ☒ None Observed
Description: _____

Cracks: ☐ Parallel with crest ☐ Perpendicular to crest ☐ Slide visible ☐ Not Visible ☒ None Observed
Description: _____

Vegetation: ☐ None ☒ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

Seepage:

Seep Spot Number 1
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

Seep Spot Number 2
☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed
☐ Flowing, Description: _____
Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____
Description: _____

***Findings:***

☐ a. The abutments/toe were not inspected.
☒ b. The abutments/toe appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The abutments/toe appeared to be in fair to poor condition and requires corrective action.
☐ d. The abutments/toe appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

☐ e. Slope protection needs maintenance or repair. Description: _____
☐ f. Rut and/or Gully erosion was observed, which requires maintenance and/or repair. Description: _____
☐ g. A crack was observed along the abutments/near the toe, which requires further investigation to determine the underlining cause. Monitor the area and/or repair as required.
☐ h. The abutment/toe area was not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.
☐ i. Tree(s) were observed along the abutment/toe. Trees have been identified as the probably cause of piping failures, and can possibly cause sever damage to the embankment if they are uprooted during a high winds. Corrective action is required to remove the tree hazards from the dam. Acceptable remedies include removal of the tree and its root structure down to a 2" diameter and reconstructing the damaged embankment section. All repair work shall be accomplished as per the requirements of licensed geotechnical or structural engineer. Routinely monitor the damaged area for signs of settlement and seepage.
☐ j. Seepage/Ponding water was observed. Monitor and conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.
☐ k. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil from the embankment. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area.
☐ l. _____

| Dam ID: MA-138<br>KAHAKAPAO RESERVOIRS | Inspection No: _____<br>Date: 4/5/06 |
|---|---|

**9. Outlet Works:**

Culvert / Pipe

Type / Size: 42"

Culvert: ☐ Concrete ☐ Masonry ☐ unlined earth ☐ Other _____

Pipe: ☒ DIP ☐ Corrugated Metal ☐ PVC ☐ HDPE ☐ Concrete ☐ Other _____

Control Type: ☐ Gate ☒ Valve ☐ Other _____

Location: ☐ Control on Upstream side ☒ Control on Downstream side

Seepage: ☐ Green Vegetation ☐ Wet or Muddy Ground ☐ Ponding Water ☐ Not Visible ☒ None Observed

☐ Flowing, Description: _____

Water Clarity: ☐ Clear ☐ Some particles ☐ Muddy ☐ Other: _____

Description: _____

***Findings:***

☒ a. The outlet works were not inspected. CONTROL HOUSE WITH UNDERGROUND PIPING FROM SUBMERGED OUTLETS IN RESERVOIRS.

☒ b. The outlet works were not tested.

☐ c. The outlet works appeared to be in satisfactory condition, no corrective actions are required at this time.

☐ d. The outlet works appeared to be in fair to poor condition and requires corrective action.

☐ e. The outlet works appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

☐ f. Seepage/Ponding water was observed. Conduct further investigation to locate the source of water and extent of any possible hazardous or developing condition.

☐ g. Seepage was observed flowing and particles were observed to be removed by the flow. Take immediate action to stop the loss of soil. Conduct further investigation to determine the underlining cause and take corrective action. Monitor the area. Failures caused by seepage/piping along the outlet conduit are very common and are considered to be a dangerous situation.

☐ h. Were not visible due to high grass and bush vegetation. Clear high vegetation and maintain low to enable easy visual inspection.

☐ i. _____

☐ j. _____

Dam ID: MA-138
KAHAKAPAO RESERVOIRS

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**10. Spillway:**

Type: ☐ None ☐ Culvert/Pipe ☐ Channel
Description: DUAL MORNING GLORY (3 FT Ø), ONE IN EACH RESERVOIR

Dimension: 3 ft. Invert elevation: 28+ ft. per staff gage

Slope Protection: ☐ None ☐ Grass ☐ Dumped Rock ☐ Fitted Rip Rap ☐ Grouted Rip Rap ☒ Concrete
☐ Defect in Protection: Description: _____

Approach: ☒ Clear ☐ High Veg. ☐ Trees ☐ Other: _____

Erosion: ☐ Scour ☐ Gully ☐ Headcut ☒ Not Observed ☐ Other: _____
Description: _____

Vegetation: ☒ None ☐ Low Ground Cover ☐ Bushes or Tall Grass ☐ Trees #_____ ☐ <6" ☐ >6" & <20" ☐ >20"
Description: _____

***Findings:***

☒ a. The Spillway appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ b. The Spillway appeared to be in fair to poor condition and requires corrective action.
☐ c. The Spillway appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

☐ d. Slope protection needs maintenance or repair. Description: _____
☐ e. The spillway approach was blocked. Clear approach.
☐ f. Severe scour erosion was observed which requires maintenance and/or repair.
Description: _____
☐ g. A headcut (vertical drop in channel due to erosion) was observed downstream of the spillway. Corrective action is required to prevent this problem from moving upstream.
☐ h. Trees are unacceptable in the spillway channel and approach. Take corrective action to address the woody vegetation problem and repair the damaged area.
☐ i. Unclear if spillway is adequately sized. Spillway should pass the probable maximum flood. Verify spillway capacity and take corrective action as required.
☐ j. _____

**11. Down Stream Channel:**

Name: NONE

Downstream: ☐ Sump ☐ Open Area ☐ Un-Defined Drainage-way ☒ Defined Drainage-way ☐ Other _____

Items along Stream Bank: ☒ None ☐ Road ☐ Houses ☐ Town GOUGE ON EITHER SIDE OF EACH SPILLWAY. ☐ Not Inspected

Description: _____

***Findings:***

☒ a. The downstream channel was not inspected. (VALLEY)
☐ b. The downstream channel appeared to be in satisfactory condition, no corrective actions are required at this time.
☐ c. The downstream channel appeared to be in fair to poor condition and requires corrective action.
☐ d. The downstream channel appeared to be in unsatisfactory condition and not expected to fulfill its intended function. Urgent corrective action is required.

***Corrective Actions:***

☐ e. _____

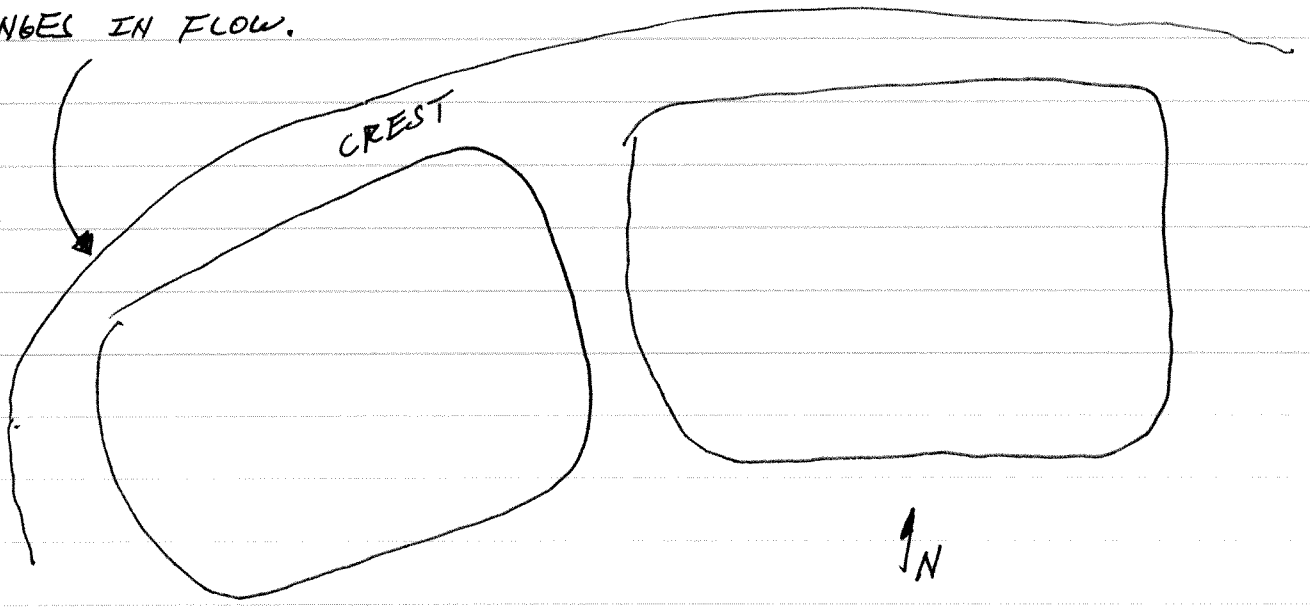
| Dam ID: MA-138<br>KAHAKAPAO RESERVOIRS | Inspection No:<br>Date: 4/5/06 |
|---|---|

**Additional Comments:**

On the date of this limited visual inspection, there appeared to be no immediate threat to the safety of the dam. No assurance can be made regarding the dam's condition after this date. Subsequent adverse weather and other factors may affect the dam's condition.

1) BASED ON VISUAL OBSERVATIONS AND DISCUSSION OF OPERATIONAL PROCEDURES OF THE DAM, THERE IS NO IMMEDIATE THREAT TO THE SAFETY OF THE DAM AT THIS TIME.

2) CONTINUE TO MONITOR KNOWN SEEP AND REPORT ANY SIGNIFICANT CHANGES IN FLOW.




**Limitations and Intent of this Dam Safety Inspection:**

This Dam Safety Inspection was conducted to assess the general overall condition of the reservoir/dam, identify visible deficiencies, and recommend areas of for monitoring, additional investigative studies and corrective actions. The inspection is based only on visible features/areas of the dam on the day of inspection. This inspection is not a formal phase I or phase II dam safety inspection and does not include a review or evaluation from each specialist of an inspection team, such as a geologists, civil, geotechnical, structural, or hydraulics engineer. The owner should verify the findings of this report and take corrective actions. The owner may submit to the State alternative corrective actions that are certified by a licensed professional engineer in the State of Hawaii experienced in the design and construction of dams. This inspection does not relieve the owner/operator from their responsibility to conduct routine inspections, maintenance, repairs, modifications, monitoring, documentation, and/or investigative studies. The inspection was conducted under the authority of the Hawaii Revised Statures Chapter 179D, and Hawaii Administrative Rules, Title 13, Chapter 190, titled "Dams and Reservoirs". Questions regarding this inspection should be forwarded to the Hawaii State Dam Safety Program; PO Box 373; Honolulu, Hawaii 96809; Ph. (808) 587-0236.

*Revised: Dec. 1, 2003*